13 to 101, and beginning with 13, a number be taken from each line alternately, a series of the first kind will be discovered, viz. one increasing by 2, 4, 6, 8, 10, &c., and every term in that series will become the first term of another similar series; so that every odd number in the small squares (except those in the top row) will be terms in 2 such series, and the indices will be as marked in the right-hand upper corner of each square; the numbers in the margin 1, 3, 5, 7, &c., and 0, 2, 4, 5, &c., are the indices of all the series, parallel to them.

Now $51 = \overset{2}{\overline{0, 1, 5, 5.}}$ No two roots differ by 9; but $5=5$; and $5+5-1=9$. As $5=5$, all the numbers below 51, that is 53, 59, &c., are divided into 4 square numbers, whose roots appear in the diagram. Again, $35=4^2$, $4^2+3=3^2$, 5^2+1, and $35=\overset{2}{\overline{-1,0,3,5,}}$ which gives 7, the index of 35, as a term in the series increasing by 2, 4, 6, &c.; and therefore every term may be resolved into 4 squares; but as one series crosses a set of series, it at length furnishes the index, thus, $\underset{-0,\,-1,\,5,\,5}{51,}$ $\underset{-1,\,-2,\,4,\,4}{37,}$ $\underset{-2,\,-3,\,3,\,3}{31,}$ on arriving at 31. $2+3=5$, the index of 31 as a term in the series increasing by 4, 8, 12, &c.; and 19 therefore equals 0, 1, 3, 3; and -1, $3=4$ (the index of 19 as a term in the 3rd series); $11=0$, 3, 1, 1.

The method by which the division of certain numbers into 4 squares is here accomplished applies to all numbers of the form $2n+1$; but as the first term increases, the methods also multiply, so as to afford increasing means of division, which must be the subject of a future communication.

XXVI. "On the Oxidation and Disoxidation effected by the Alkaline Peroxides." By B. C. Brodie, Esq., F.R.S., Professor of Chemistry in the University of Oxford. Received June 19, 1862.

(Abstract.)

A preliminary notice containing an abstract of the greater portion of this paper has already appeared*.

Having shown that the alkaline peroxides are capable of acting either as agents of oxidation or reduction, the author proceeds to

* See 'Proceedings,' vol. xi. p. 442.

connect the double function of this class of peroxides with the peculiar catalytic decompositions which they undergo. It is shown that the catalytic decomposition may be regarded as a combination of these two actions, an oxidation and a reduction simultaneously occurring. Thus in an alkaline solution of the peroxide of hydrogen, protoxide of manganese is oxidized to peroxide. In the acid solution the peroxide of manganese is reduced to protoxide, the results being expressed in the following equations:—

$$Mn_2O + H_2O_2 = H_2O + Mn_2O_2,$$
$$Mn_2O_2 + H_2O_2 = Mn_2O + H_2O + O_2;$$

while the result of the catalytic decomposition effected by the peroxide of manganese is given in the equation derived from the above by elimination,

$$2H_2O_2 = 2H_2O + O_2,$$

the result being the same as though the peroxide of manganese were alternately reduced and oxidized by the alkaline peroxide. We are thus enabled to analyse the catalytic action into its constituent decompositions.

That in numerous cases the catalytic change is brought about by the intervention of intermediate compounds, which are alternately formed and destroyed during the action, is shown in various examples. For instance, the addition of a solution of peroxide of sodium to an excess of a solution of a protosalt of copper causes the formation of a precipitate of a yellow peroxide of copper. If, on the other hand, a few drops of the salt of copper be added to an excess of the alkaline peroxide, the same yellow body is formed, but the whole of the peroxide is ultimately decomposed; after the decomposition hydrated protoxide of copper remains. Similar phenomena occur with an ammoniacal solution of the copper-salt. If a few drops of this solution be added to an ammoniacal solution of the peroxide of hydrogen, the solution becomes of a yellow colour, and the catalytic action is set up. This action may continue, in dilute solutions, for several hours; during the whole of this time the yellow colour is permanent; but ultimately, when the peroxide is entirely decomposed, the blue colour of the ammoniacal solution of the protoxide reappears. The ammoniacal solution of the protoxide of copper decomposes the peroxide of hydrogen into water and oxygen, precisely as sulphuric acid decomposes alcohol into ether and water. But in this case the colour of the solution gives actual evidence of the

presence of the intermediate compound by the agency of which the catalytic action is effected, and which is formed, but disappears from the final result.

XXVII. "On the Relative Speed of the Electric Wave through Submarine Cables of different lengths, and a Unit of Speed for comparing Electric Cables by bisecting the Electric Wave." By CROMWELL F. VARLEY, Esq. Communicated by Professor STOKES, Sec. R.S. Received June 19, 1862.

(Abstract.)

The present paper gives the results of some experiments which were undertaken to determine, first, the relative speed of the electric wave through cables of various lengths; secondly, the retarding effect of the iron covering of the cable; and thirdly, methods for the increase of the speed of the electric wave.

When a long submarine cable or subterranean wire is connected at one end through a galvanometer to the earth, and the other end is connected with a battery, a current flows through it, deflecting the galvanometer-needle.

If the needle be made very light and small, so as to have but a small amount of inertia, and the cable be long, the current will be seen to arrive after the lapse of a short but appreciable interval of time, and will gradually augment in intensity approaching to, but never attaining, the maximum.

Professor Thomson has investigated this subject mathematically, and arrived at the conclusion that in submarine cables of different lengths the speed is inversely as the square of the distance.

Through the Atlantic Cable, the conducting wire of which weighed 93 lbs. to the statute mile, and the length of which was rather more than 2300 statute miles, the electric current did not show itself on Thomson's sensitive reflecting galvanometer until more than one second after contact had been made with the battery at the other end.

In experiments made by the author in 1854 upon 1600 miles of wire between London and Manchester, connected up in one continuous circuit, the current was not visible upon the chemical recording instruments then in use until after the lapse of about three seconds.

These experiments were repeated by Professor Faraday; and he has made known the results.